

WIRELESS COMMUNICATION SYSTEM, WIRELESS COMMUNICATION  
SETTING METHOD, WIRELESS COMMUNICATION APPARATUS,  
WIRELESS COMMUNICATION SETTING PROGRAM, AND WIRELESS  
COMMUNICATION SETTING PROGRAM STORAGE MEDIUM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a wireless communication system, a wireless communication setting method, a wireless communication apparatus, a wireless communication setting program, and a wireless communication setting program storage medium and, more particularly, to those suitably applicable to execute setting work on each of a plurality of wireless communication apparatus such that mutual wireless communication is established between these apparatuses.

2. Description of the Related Art

With some related-art wireless communication systems, each of the wireless communication apparatuses is adapted to execute mutual wireless data communication on the basis of a standard such as IEEE 802.11b for example (refer to Japanese Patent Laid-open No. Hei 10-93508).

For example, in order to provide mutual wireless data communication between a first wireless communication apparatus 101 and a second wireless communication apparatus 102 shown in FIG. 20, it is necessary to manually enter setting information I101 and setting information I102 into the first wireless communication apparatus 101 and the second wireless communication apparatus 102, respectively, as shown in FIG. 21.

The following describes contents of these pieces of setting information I101 and I102. For example, communication destination information (an IP (Internet Protocol) address for example) is set to the first setting information I101 to be entered in the first wireless communication apparatus 101 so as to identify the second wireless communication apparatus 102 that is the destination of wireless data communication. Also, wireless network identification information (SSID (Service Set Identifier) for example) is set to this

first setting information I101 so as to identify a wireless network (or a wireless LAN (Local Area Network)) that is formed between the first wireless communication apparatus 101 and the second wireless communication apparatus 102. In addition, cryptographic key information (WEP (Wired Equivalent Privacy) key for example) is set to the first setting information I101 so as to encrypt data to be transferred with the second wireless communication apparatus 102.

On the other hand, communication destination identification information is set to the second setting information I102 to be entered in the second wireless communication apparatus 102 so as to identify the first wireless communication apparatus 101 that is the destination of wireless data communication. Also, the same wireless network identification information and cryptographic key information as those to be set to the first wireless communication apparatus 101 are set to the second setting information I102.

Consequently, the first wireless communication apparatus 101 can identify the second wireless communication apparatus 102 as the destination of wireless data communication on the basis of the communication destination information set to the first

setting information I101. Also, the second wireless communication apparatus 102 can identify the first wireless communication apparatus 101 as the destination of wireless data communication on the basis of the communication destination information set to the second setting information I102. Therefore, the first wireless communication apparatus 101 and the second wireless communication apparatus 102 become ready for wireless data communication bidirectionally, thereby transferring data mutually.

Actually, the first wireless communication apparatus 101 and the second wireless communication apparatus 102 determine whether the wireless network identification information set to these apparatuses is identical with each other. If these pieces of identification information are found identical, the apparatuses 101 and 102 can wirelessly communicate with each other. Consequently, the first wireless communication apparatus 101 and the second wireless communication apparatus 102 can prevent interference from other wireless communication apparatuses to which wireless network identification information different from the wireless network identification information set to these wireless communication apparatuses 101 and 102.

This configuration enhances the security of the wireless data communication between the first wireless communication apparatus 101 and the second wireless communication apparatus 102.

Further, the first wireless communication apparatus 101 and the second wireless communication apparatus 102 are adapted to encrypt data to be wirelessly communicated, by use of the same cryptographic key information as set to each thereof. Consequently, any other wireless communication apparatuses to which different cryptographic key information from the cryptographic key information set to the first wireless communication apparatus 101 and the second wireless communication apparatus 102 is set are prevented from decrypting the intercepted encrypted data, if any, communicated between the first wireless communication apparatus 101 and the second wireless communication apparatus 102. Thus, this configuration enhances the security of the wireless data communication between the first wireless communication apparatus 101 and the second wireless communication apparatus 102.

#### SUMMARY OF THE INVENTION

In order to provide mutual wireless data

communication between the first wireless communication apparatus 101 and the second wireless communication apparatus 102 in a wireless communication system having the above-mentioned configuration, it is necessary to manually enter communication destination identification information, wireless network identification information, and cryptographic key information into the first wireless communication apparatus 101 as the first setting information I101 and the second wireless communication apparatus 102 as the second setting information I102. Therefore, the above-mentioned related-art involves a problem of the inconvenience in setting necessary information to the first wireless communication apparatus 101 and the second wireless communication apparatus 102, for example.

Therefore, the present invention addresses the above-identified and other problems associated with related-art methods and apparatuses and solves the addressed problems by providing a wireless communication system, a wireless communication setting method, a wireless communication apparatus, a wireless communication setting program, and a wireless communication setting program storage medium that are capable of setting wireless communication apparatuses

significantly easily.

According to an embodiment of the present invention, a wireless communication system has a plurality of wireless communication apparatuses and a proximity wireless communication apparatus. The plurality of wireless communication apparatuses each has a setting block to which a wireless data communication destination is set and a wireless data communication block for executing wireless data communication with the wireless data communication destination set to the setting block. The proximity wireless communication apparatus executes wireless communication with any of the plurality of wireless communication apparatuses brought into proximity of a predetermined range of the proximity wireless communication apparatus. The proximity wireless communication apparatus has a storage block and a wireless transmission block. The storage block stores communication mate identification information received from the wireless communication apparatuses brought into proximity of the proximity wireless communication apparatus for identifying the wireless communication apparatus as a communication mate. The wireless transmission block transmits communication mate identification information if stored in the storage block

to the wireless communication apparatus brought into proximity of the proximity wireless communication apparatus. Each of the above-mentioned wireless communication apparatuses has a wireless transmission block and a setting control block. The wireless transmission block transmits, to the proximity wireless communication apparatus, communication mate identification information, if the communication mate identification information is not stored in the proximity wireless communication apparatus brought into proximity of the wireless communication apparatus, for identifying the wireless communication apparatus itself as a communication mate. The setting control block sets the wireless communication apparatus to the setting block as a wireless data communication destination. The wireless communication apparatus is identified by the communication mate identification information received from the proximity wireless communication apparatus if the communication mate identification information is stored in the proximity wireless communication apparatus brought into proximity of the wireless communication apparatus.

As described, it is possible to store the communication mate identification information for

identifying that wireless communication apparatus as a communication mate into the proximity wireless communication apparatus by bringing the proximity wireless communication apparatus in which communication mate identification information is not stored to the proximity of any one of the wireless communication apparatuses. Then, it is possible to set the wireless communication apparatus identified by this communication mate identification information to another wireless communication apparatus as the destination of wireless data communication by bringing the proximity wireless communication apparatus in which this communication mate identification information is stored to the other wireless communication apparatus.

According to an embodiment of the present invention, it is possible to store the communication mate identification information for identifying that wireless communication apparatus as a communication mate into the proximity wireless communication apparatus by bringing the proximity wireless communication apparatus in which communication mate identification information is not stored to the proximity of any one of the wireless communication apparatuses. Then, it is possible to set the wireless communication apparatus identified by this

communication mate identification information to another wireless communication apparatus as the destination of wireless data communication by bringing the proximity wireless communication apparatus in which this communication mate identification information is stored to the other wireless communication apparatus. This novel configuration allows the setting of necessary setting information to each wireless communication apparatus without requiring operator's manual entry of the setting information, thereby significantly facilitating the setting work of wireless communication apparatuses.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view illustrating an exemplary configuration of a wireless communication system practiced as one embodiment of the invention;

FIG. 2 is a block diagram illustrating an exemplary configuration of a wireless communication apparatus;

FIGS. 3A and 3B are schematic diagrams describing temporary setting information and first setting information;

FIG. 4 is a block diagram illustrating an exemplary configuration of a non-contact IC card;

FIG. 5 is a schematic diagram illustrating a packet

structure at the time of storage status notification;

FIG. 6 is a schematic diagram illustrating a status in which temporary information is stored in the above-mentioned non-contact IC card;

FIG. 7 is a schematic diagram illustrating a packet structure at the time of temporary information transmission;

FIG. 8 is a schematic diagram illustrating a status in which temporary setting information stored in the above-mentioned non-contact IC card is stored in the above-mentioned wireless communication apparatus;

FIG. 9 is a schematic diagram illustrating second setting information;

FIG. 10 is a schematic diagram illustrating a status in which completion of setting is notified;

FIG. 11 is a schematic diagram illustrating a packet structure at the time of setting completion notification;

FIG. 12 is a schematic diagram illustrating a status in which bidirectional wireless data communication is ready;

FIG. 13 is a flowchart indicative of a setting processing procedure;

FIG. 14 is a flowchart indicative of a temporary

setting information write processing procedure;

FIG. 15 is a flowchart indicative of a temporary setting information read processing procedure;

FIG. 16 is a schematic diagram illustrating a card detection processing control screen;

FIG. 17 is a schematic diagram illustrating exemplary wireless data communication executed via an access point;

FIG. 18 is a schematic diagram illustrating a wireless data communication system (1) in which one wireless communication apparatus executes wireless data communication with a plurality of wireless communication apparatuses;

FIG. 19 is a schematic diagram illustrating a wireless data communication system (2) in which one wireless communication apparatus executes wireless data communication with a plurality of wireless communication apparatuses;

FIG. 20 is a schematic diagram illustrating a status in which there is no connection between wireless communication apparatuses; and

FIG. 21 is a schematic diagram illustrating a status in which necessary information is set to each wireless communication apparatus.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention will be described in further detail by way of embodiments thereof with reference to the accompanying drawings.

### (1) Configuration of a wireless communication system

Now, referring to FIG. 1, a numeral 1 indicates a wireless communication system as a whole. The wireless communication system 1 has a first wireless communication apparatus 2A, a second wireless communication apparatus 2B, and a non-contact IC (Integrated Circuit) card 3 that are capable of wireless data communication based on a standard such as IEEE 802.11b, for example.

The following describes a configuration of the first wireless communication apparatus 2A with reference to FIG. 2. The first wireless communication apparatus 2A has a setting information storage block 4 for storing setting information indicative of communication destination identification information for identifying a destination of wireless data communication. A control block 5 for executes overall control on the whole first wireless communication apparatus 2A. The control block 5 refers to communication destination identification

information in the setting information stored in the setting information storage block 4. Then, the control block 5 executes the wireless data communication based on a standard such as IEEE 802.11b for example with a wireless data communication destination identified by the referenced communication destination identification information via a wireless communication block 6 and a wireless communication antenna 7. Also, the first wireless communication apparatus 2A has a proximity wireless communication antenna 8 and a proximity wireless communication block 9 for executing wireless communication with the non-contact IC card 3 that comes close to a predetermined range. The control block 5 of the first wireless communication apparatus 2A is connected to an operator block 11 and a display block 12 via an input/output interface block 10. It should be noted that the second wireless communication apparatus 2B according to the present embodiment has circuit blocks (4 through 11) generated in generally the same manner as those of the first wireless communication apparatus 2A.

At this moment, because a setting operation has not been executed on the first wireless communication apparatus 2A, temporary setting information It as shown in FIG. 3A for example is stored in the setting

information storage block 4 of the first wireless communication apparatus 2A. This temporary setting data It contains communication mate identification information IPS1 (in this case, an IP address allocated to the first wireless communication apparatus 2A), wireless network identification information SID (in this case, SSID), and cryptographic key information WK (in this case, a WEP key). The communication mate identification information IPS1 makes the destination of wireless data communication identify the first wireless communication apparatus 2A itself as the communication mate. The wireless network identification information SID identifies a wireless network formed between the source and the destination of wireless data communication. The cryptographic key information WK encrypts data to be transferred with the destination of wireless data communication.

In the present embodiment, device unique information (in this case, MAC (Media Access Control) address) unique to the first wireless communication apparatus 2A is allocated as wireless network identification SID contained in this temporary setting information It. This configuration prevents the wireless network formed by the first wireless communication apparatus 2A and the wireless network formed by the other

wireless communication apparatus from getting into contention. In the present embodiment, because this temporary setting information It contains an IP address of class C (192. 168. .... ) as communication mate identification information IPS1, a sub net mask (255. 255. 255. 0) for example corresponding to this IP address is also included. In addition, temporary setting information It in this case has an ad hoc mode (Ad hoc) for allowing the first wireless communication apparatus 2A to directly wirelessly communicate with the wireless communication destination without using the access point.

When a non-contact IC card detection command operation is executed through the operator block 11 of the first wireless communication apparatus 2A to detect the non-contact IC card 3, the control block 5 of the first wireless communication apparatus 2A executes detection processing for detecting the non-contact IC card 3. Actually, in this detection processing, the control block 5 of the first wireless communication apparatus 2A is adapted to repetitively wirelessly transmit at predetermined time intervals a storage status notification request signal for requesting the non-contact IC card 3 to notify whether or not temporary setting information It is stored, via the proximity

wireless communication block 9 and the proximity wireless communication antenna 8 in this order (this is known as polling processing).

When the non-contact IC card 3 is brought to the proximity of the proximity wireless communication antenna 8 arranged on the first wireless communication apparatus 2A, a control block 12 of the non-contact IC card 3 shown in FIG. 4 accordingly receives the storage status notification request signal wirelessly transmitted from the first wireless communication apparatus 2A, via an antenna 13 and a communication block 14. Receiving the storage status notification request signal, the control block 12 checks that temporary setting information It is not stored in a temporary setting information storage block 15 and then transmits a storage status notification signal indicative that temporary setting information It is not stored, via the communication block 14 and the antenna 13. In the case of the present embodiment, this storage status notification signal has packet structure as shown in FIG. 5, in which information indicative whether or not temporary setting information It is stored is included in control information.

The control block 5 of the first wireless communication apparatus 2A receives the storage status

notification signal from the non-contact IC card 3 via the proximity wireless communication antenna 8 and the proximity wireless communication block 9 in this order. If temporary setting information It is found not stored in the non-contact IC card 3, accordingly reads temporary setting information It from the setting information storage block 4, thereby wirelessly transmitting the read temporary setting information to the non-contact IC card 3 via the proximity wireless communication block 9 and the proximity wireless communication antenna 8 in this order.

Receiving temporary setting information It from the first wireless communication apparatus 2A via the antenna 13 and the communication block 14, the control block 12 of the non-contact IC card 3 stores the received information into the temporary setting information storage block 15.

Thus, in the wireless communication system 1, it is possible to store temporary setting information It from the first wireless communication apparatus 2A into the non-contact IC card 3 by only bringing the non-contact IC card 3 to the proximity of the first wireless communication apparatus 2A as shown in FIG. 6.

Then, when a non-contact IC card detection command

operation is executed through the operator block 11 of the second wireless communication apparatus 2B to detect the non-contact IC card 3, the control block 5 of the second wireless communication apparatus 2B executes detection processing for detecting the non-contact IC card 3. Actually, in this detection processing, the control block 5 of the second wireless communication apparatus 2B is adapted to repetitively wirelessly transmit at predetermined time intervals a storage status notification request signal for requesting the non-contact IC card 3 to notify whether or not temporary setting information It is stored, via the proximity wireless communication block 9 and the proximity wireless communication antenna 8 in this order.

When the non-contact IC card 3 is brought to the proximity of the proximity wireless communication antenna 8 arranged on the second wireless communication apparatus 2B, the control block 12 of the non-contact IC card 3 accordingly receives the storage status notification request signal wirelessly transmitted from the second wireless communication apparatus 2B, via an antenna 13 and a communication block 14. Receiving the storage status notification request signal, the control block 12 of the non-contact IC card 3 checks that temporary

setting information It is stored in a temporary setting information storage block 15 and then transmits a storage status notification signal indicative that temporary setting information It is stored, via the communication block 14 and the antenna 13.

The control block 5 of the second wireless communication apparatus 2B receives the storage status notification signal from the non-contact IC card 3 via the proximity wireless communication antenna 8 and the proximity wireless communication block 9 in this order. If temporary setting information It is found stored in the non-contact IC card 3, accordingly reads temporary setting information It from the setting information storage block 4, thereby wirelessly transmitting a temporary setting information transmission request signal via the proximity wireless communication block 9 and the proximity wireless communication antenna 8 in this order to request the non-contact IC card 3 for transmitting temporary setting information It.

Receiving the temporary setting information transmission request signal from the second wireless communication apparatus 2B via the antenna 13 and the communication block 14 in this order, the control block 12 of the non-contact IC card 3 reads temporary setting

information It from the temporary setting information storage block 15 and wirelessly transmits the read temporary setting information via the communication block 14 and the antenna 13 in this order. In this case, temporary setting information It is wirelessly transmitted from the non-contact IC card 3 on the basis of a packet structure shown in FIG. 7.

Thus, the control block 5 of the second wireless communication apparatus 2B receives temporary setting information It from the non-contact IC card 3 via the proximity wireless communication antenna 8 and the proximity wireless communication block 9 in this order and stores the received information into the setting information storage block 4.

Thus, in the wireless communication system 1, it is possible to store temporary setting information It stored in the non-contact IC card 3 from the first wireless communication apparatus 2A into the second wireless communication apparatus 2B by only bringing the non-contact IC card 3 to the proximity of the second wireless communication apparatus 2B as shown in FIG. 8.

Next, the control block 5 of the second wireless communication apparatus 2B generates setting information necessary for wireless data communication on the basis of

temporary setting information It stored in the setting information storage block 4 (in what follows, the setting information to be set to the first wireless communication apparatus 2A is referred to as "first setting information" and the setting information to be set to the second wireless communication apparatus 2B is referred to as "second setting information" for the convenience of description).

To be more specific, the control block 5 of the second wireless communication apparatus 2B determines that communication mate identification information IP1 indicated in this temporary setting information It (FIG. 3A) as information for identifying the destination of wireless data communication of the second wireless communication apparatus 2B. Then, the control block 5 sets this communication mate identifying information IPS1 to second setting information I2 as communication destination identification information IPT2 as shown in FIG. 9. Thus, the control block 5 of the second wireless communication apparatus 2B can set, as second setting information I2, communication destination identification information IPT2 for identifying the first wireless communication apparatus 2A that becomes the destination of wireless data communication.

In addition, the control block 5 of the second wireless communication apparatus 2B generates communication mate identification information IPS2 so that the destination of wireless data communication identifies the second wireless communication apparatus 2B itself as the communication mate of wireless data communication. This communication mate identification information IPS2 is generated so as not to overlap communication destination identification information IPT2 that was set. Further, the control block 5 of the second wireless communication apparatus 2B sets wireless network identification information SID and cryptographic key information WK contained in this temporary setting information It directly to second setting information I2. Because the ad hoc mode is set to this temporary setting information It in the present embodiment, the control block 5 of the second wireless communication apparatus 2B sets the ad hoc mode to second setting information I2 in the same manner. Also, the control block 5 of the second wireless communication apparatus 2B sets a sub net mask contained in this temporary setting information It directly to second setting information I2.

Then, the first and second wireless communication apparatuses 2A and 2B wirelessly communicate with each

other to determine whether there is a match between wireless network identification information SID set to the second wireless communication apparatus 2B and wireless network identification information SID set to the first wireless communication apparatus 2A. If a match is found, then a wireless network made up of the first and second wireless communication apparatuses 2A and 2B is formed as shown in FIG. 10.

Next, the control block 5 of the second wireless communication apparatus 2B transmits a setting completion notification signal indicative of the completion of setting of second setting information I2 to the first wireless communication apparatus 2A identified by communication destination identification information IPT2 contained in second setting information I2, via the wireless communication block 6 and the wireless communication antenna 7. In the present embodiment, this setting completion notification signal has a packet structure as shown in FIG. 11 and contains, in the header thereof, communication mate identification information IPS2 for identifying the second wireless communication apparatus 2B as the mate of communication.

Receiving the setting notification completion signal from the second wireless communication apparatus

2B via the wireless communication antenna 7 and the wireless communication block 6, the control block 5 of the first wireless communication apparatus 2A determines that communication mate identification information IPS2 contained in the received setting completion notification information as information for identifying the destination of wireless data communication of the first wireless communication apparatus 2A. Then, the control block 5 generates first setting information I1 by setting this communication mate identification information IPS2 to temporary setting information It as communication destination identification information IPT1 as shown in FIG. 3B. Thus, the control block 5 of the first wireless communication apparatus 2A can set, as first setting information I1, communication destination identification information IPT1 for identifying the second wireless communication apparatus 2B that becomes the destination of wireless data communication.

Consequently, the first wireless communication apparatus 2A can identify the second wireless communication apparatus 2B as the destination of wireless data communication on the basis of communication destination identification information IPT1 contained in first setting information I1 that was set. The second

wireless communication apparatus 2B also can identify the first wireless communication apparatus 2A as the destination of wireless data communication on the basis of communication destination identification information IPT2 contained in second setting information I2 that was set. As a result, the first and second wireless communication apparatus 2A and 2B can bidirectionally wirelessly communicate with each other via the wireless communication block 6 and the wireless communication antenna 7 as shown in FIG. 12, thereby transferring data with each other.

Both the first and second wireless communication apparatuses 2A and 2B have same cryptographic key information WK. Therefore, if the first wireless communication apparatus 2A encrypts data by use of cryptographic key WK set to first setting information I1 and then wirelessly transmits the encrypted data to the second wireless communication apparatus 2B, the second wireless communication apparatus 2B that receives this encrypted data can decrypt it by use of cryptographic key information WK set to second setting information I2.

## (2) Setting processing procedures

The following describes setting processing procedure RT1 to be executed when setting information is

set to the first and second wireless communication apparatuses 2A and 2B with reference to flowcharts shown in FIGS. 13, 14, and 15. First, the execution of setting processing procedure RT1 by the first wireless communication apparatus 2A will be described, followed by the execution of setting processing procedure RT1 by the second wireless communication apparatus 2B.

(2-1) Execution of a setting processing procedure by the first wireless communication apparatus

In step SP1 shown in FIG. 13, when a non-contact IC card detection command operation is executed through the operator block 11, the control block 5 of the first wireless communication apparatus 2A executes detection processing for detecting the non-contact IC card 3. Actually, in this detection processing, the control block 5 of the first wireless communication apparatus 2A repetitively wirelessly transmits at predetermined time intervals a storage status notification request signal for requesting the non-contact IC card 3 to notify whether or not temporary setting information It is stored, via the proximity wireless communication block 9 and the proximity wireless communication antenna 8 in this order.

In the present embodiment, when card detection start button B1 in a card detection processing control

screen (FIG. 16) displayed on the control block 12 is pressed through the operator block 11, the control block 5 of the first wireless communication apparatus 2A recognizes the pressing as a non-contact IC card detection command operation, thereby executing detection processing. When card detection end button B2 in this card detection processing control screen is pressed through the operator block 11, the control block 5 of the first wireless communication apparatus 2A stops detection processing. Thus, the first wireless communication apparatus 2A is adapted to start or stop detection processing in accordance with a user operation, so that power consumption can be significantly saved as compared with the constant execution of detection processing. In addition, the control block 5 of the first wireless communication apparatus 2A is adapted to display a status of communication with the destination of wireless data communication onto communication status display area AR1 in this card detection processing control screen.

Next, in step SP2, the control block 5 of the first wireless communication apparatus 2A receives the storage status notification signal from the non-contact IC card 3 and determines whether temporary setting information It is stored in the non-contact IC card 3 on the basis of

the received storage status notification signal.

In this case, the control block 5 of the first wireless communication apparatus 2A determines that temporary setting information It is not stored in the non-contact IC card 3 on the basis of the received storage status notification signal, upon which the procedure goes to subroutine SRT1 to execute temporary setting information write processing.

The control block 5 of the first wireless communication apparatus 2A moves to step SP11 of temporary setting information write processing procedure SRT1 shown in FIG. 14 to generate packets for transmitting temporary setting information It from the setting information storage block 4 to the non-contact IC card 3.

Next, the control block 5 of the first wireless communication apparatus 2A moves to step SP12 to wirelessly transmit temporary setting information It to the non-contact IC card 3 by means of the generated packets.

Next, the control block 5 of the first wireless communication apparatus 2A moves to step SP13 and wirelessly communicates with the non-contact IC card 3 to determine whether temporary setting information has been

written to the non-contact IC card 3.

If the decision is No in step SP13, then it indicates that transmitted temporary setting information It is not correctly stored in the temporary setting information storage block 15 of the non-contact IC card 3. Then, the control block 5 of the first wireless communication apparatus 2A determines that temporary setting information It has not been written and moves to step SP14 to display error information indicative thereof onto the control block 12. Then, the control block 5 moves to end step SP15 to end this temporary setting information write processing procedure SRT1.

On the other hand, if the decision in step SP13 is Yes, it indicates that transmitted temporary setting information is correctly stored in the temporary setting information storage block 15 of the non-contact IC card 3. The control block 5 of the first wireless communication apparatus 2A moves to step SP16 to get in a wait status for a setting completion notification signal from the destination of wireless data communication (in this case, the second wireless communication apparatus 2B).

Next, the control block 5 of the first wireless communication apparatus 2A determines in step SP17 whether a setting completion notification signal has been

received from the destination of wireless communication. If the setting completion notification signal is found not received, then the control block 5 moves to step SP18 to determine whether to execute a time-out operation.

If the decision is Yes in step SP18, it indicates that a predetermined time has passed since the setting completion notification signal wait status. Then, the control block 5 of the first wireless communication apparatus 2A moves to step SP19 to display error information on the display block 12 indicative that the setting completion notification signal has not been received. Then, the control block 5 moves to end step SP15 to end this temporary setting information write processing procedure SRT1. On the other hand, if the decision in step SP18 is No, it indicates that a predetermined time has not passed since the setting completion notification signal wait status. Then, the control block 5 of the first wireless communication apparatus 2A returns to step SP16 to wait for the setting completion notification signal from the destination of wireless data communication.

Meanwhile, if a setting completion notification signal has been received from the second wireless communication apparatus 2B that is the destination of

wireless data communication, the decision in step SP17 is Yes and the control block 5 of the first wireless communication apparatus 2A moves to step SP20.

In step SP20, the control block 5 of the first wireless communication apparatus 2A generates first setting information I1 on the basis of the setting completion notification signal received from the second wireless communication apparatus 2B. As a result, the control block 5 of the first wireless communication apparatus 2A starts wireless data communication with the second wireless communication apparatus 2B as shown in FIG. 12 and, at the same time, displays information indicative of the start of wireless data communication onto the control block 12, upon which the control block 5 moves to step SP15 to end this temporary setting information write processing procedure SRT1.

(2-2) Execution of a setting processing procedure by the second wireless communication apparatus

When a non-contact IC card detection command operation is executed through the operator block 11 in step SP1 shown in FIG. 13, the control block 5 of the second wireless communication apparatus 2B executes detection processing for detecting the non-contact IC card 3. Actually, in this detection processing, the

control block 5 of the second wireless communication apparatus 2B repetitively wirelessly transmits at predetermined time intervals a storage status notification request signal for requesting the non-contact IC card 3 to notify whether or not temporary setting information It is stored, via the proximity wireless communication block 9 and the proximity wireless communication antenna 8 in this order.

Next, in step SP2, the control block 5 of the second wireless communication apparatus 2B receives the storage status notification signal from the non-contact IC card 3 and determines whether temporary setting information It is stored in the non-contact IC card 3 on the basis of the received storage status notification signal.

In this case, the control block 5 of the second wireless communication apparatus 2B determines that temporary setting information It is stored in the non-contact IC card 3 on the basis of the received storage status notification signal, upon which the procedure goes to subroutine SRT2 to execute temporary setting information read processing.

The control block 5 of the second wireless communication apparatus 2B moves to step SP31 of

temporary setting information read processing procedure SRT2 shown in FIG. 15 to wirelessly transmit a temporary setting information transmission request signal for requesting the non-contact IC card 3 for the transmission of temporary setting information It.

Next, in step SP32, the control block 5 of the second wireless communication apparatus 2B determines whether temporary setting information It has been read from the non-contact IC card 3.

If the decision in step SP32 is No, it indicates that the reading of temporary setting information It failed because temporary setting information It has not been received from the non-contact IC card 3. Then, the control block 5 of the second wireless communication apparatus 2B moves to step SP33 and displays error information indicative of the failure of reading of temporary setting information It onto the control block 12. Then, the control block 5 moves to end step SP34 to end this temporary setting information read processing procedure SRT2.

On the other hand, if the decision in step SP32 is Yes, it indicates that the reading of temporary setting information It is successful because temporary setting information has been received from the non-contact IC

card 3. Then, the control block 5 of the second wireless communication apparatus 2B moves to step SP35 to generate second setting information I2 on the basis of the read temporary setting information It.

Next, the control block 5 of the second wireless communication apparatus 2B moves to step SP36 and transmits a setting completion notification signal indicative of the completion of setting of second setting information I2 to the first wireless communication apparatus 2A through the wireless communication block 6 and the wireless communication antenna 7. Then, the control block 5 moves to end step SP34 to end this temporary setting information read processing procedure SRT2.

### (3) Operation and effects

In the above-mentioned configuration, the wireless communication system 1 has the first and second wireless communication apparatuses 2A and 2B that are capable of wireless data communication and the non-contact IC card 3 that is capable of wirelessly communicating with the first and second wireless communication apparatuses 2A and 2B that are arranged in proximity within a predetermined range.

The first and second wireless communication

apparatuses 2A and 2B have each the setting information storage block 4, the wireless communication block 6, and the proximity wireless communication block 9. The setting information storage block 4 stores setting information containing communication destination identification information for identifying the destination of wireless data communication. The wireless communication block 6 wirelessly communicates with the destination of wireless data communication that is identified by the communication destination identification information contained in the setting information stored in the setting information storage block 4. The proximity wireless communication block 9 has proximity wireless communication with the non-contact IC card 3 brought to the proximity of a predetermined range.

If the control block 5 of the first wireless communication apparatus 2A for example recognizes that temporary setting information It is not stored in the non-contact IC card 3 brought to proximity with the state that first setting information I1 and second setting information I2 are not set to the first and second wireless communication apparatuses 2A and 2B respectively, the control block 5 wirelessly transmits temporary setting information It to the non-contact IC card 3. The

information It contains communication mate identification information IPS1 so that the destination of wireless communication identify the first wireless communication apparatus 2A as the communication mate. At this moment, receiving temporary setting information It from the first wireless communication apparatus 2A, the control block 12 of the non-contact IC card 3 stores the received temporary setting information It into the temporary setting information storage block 15.

Then, when the non-contact IC card 3 storing this temporary setting information It is brought to the proximity of the second wireless communication apparatus 2B and the control block 5 thereof accordingly recognizes that temporary setting information It is stored in this non-contact IC card 3, the control block 5 wirelessly transmits a temporary setting information transmission request signal for requesting the transmission of this temporary setting information It to the non-contact IC card 3. At this moment, receiving this temporary setting information transmission request signal, the non-contact IC card 3 accordingly wirelessly transmits temporary setting information It from the temporary setting information storage block 15 to the second wireless communication apparatus 2B.

The control block 5 of the second wireless communication apparatus 2B receives temporary setting information It from the non-contact IC card 3 and sets communication mate identification information IPS1 contained in the received temporary setting information It as communication mate identification information IPT2, thereby generating second setting information I2.

Next, the control block 5 of the second wireless communication apparatus 2B wirelessly transmits a setting completion notification signal indicative of communication mate identification information IPS2 for identifying the second wireless communication apparatus 2B as the mate of communication by the destination of wireless communication to the first wireless communication apparatus 2A. The apparatus 2A is identified by communication destination identification information IPT2 contained in second setting information I2.

Consequently, receiving the setting completion notification signal from the second wireless communication apparatus 2B, the control block 5 of the first wireless communication apparatus 2A sets communication mate identification information IPS2 contained in the received setting completion notification

signal as communication destination identification information IPT1, thereby generating first setting information I1.

Therefore, only by bringing the non-contact IC card 3 to the proximity of the first wireless communication apparatus 2A and then bringing the non-contact IC card 3 to the proximity of the second wireless communication apparatus 2B, the user can set first setting information I1 containing communication destination identification information IPT1 for identifying the second wireless communication apparatus 2B to the first wireless communication apparatus 2A. At the same time, the user can set second setting information I2 containing communication destination identification information IPT2 for identifying the first wireless communication apparatus 2A to the second wireless communication apparatus 2B.

Consequently, the first and second wireless communication apparatuses 2A and 2B can identify each other as the destination of wireless data communication on the basis of first setting information I1 and second setting information I2 set thereto respectively, thereby transferring data with each other by wireless data communication.

In the present embodiment, the first wireless communication apparatus 2A is adapted to set also wireless network identification information SID and cryptographic key information WK to temporary setting information It to be written to the non-contact IC card 3. Consequently, the second wireless communication apparatus 2B that reads temporary setting information It from the non-contact IC card 3 can set the same wireless network identification information SID and cryptographic key information WK as those of the first wireless communication apparatus 2A to second setting information I2 on the basis of this temporary setting information It. As a result, the first and second wireless communication apparatuses 2A and 2B can form a wireless network composed thereof and encrypt data to be transferred with each other, thereby enhancing the security of wireless data communication.

In the present embodiment, an example is used in which the first and second wireless communication apparatuses 2A and 2B execute wireless data communication in the ad hoc mode. However, the present invention is not limited to this example. For example, as shown in FIG. 17, the present invention is also applicable when the first and second wireless communication apparatuses 2A and 2B

execute wireless data communication via access point AP. In this case, the first and second wireless communication apparatuses 2A and 2B can be set by procedures similar to those described above, except that wireless network identification information SID contained in temporary setting information It temporarily set to the first wireless communication apparatus 2A is matched with wireless network identification information SID set to access point AP in advance.

According to the above-mentioned configurations, in the non-contact IC card 3, communication mate identification information IPS1 can be stored for identifying this first wireless communication apparatus 2A as the mate of communication by bringing the non-contact IC card 3 storing no communication mate identification information to the proximity of the first wireless communication apparatus 2A. The first wireless communication apparatus 2A to be identified by this communication mate identification information IPS1 is set to the second wireless communication apparatus 2B as the destination of wireless data communication by bringing this non-contact IC card 3 storing this communication mate identification information IPS1 to the proximity of the second wireless communication apparatus 2B. This

configuration saves the manual input of setting information to each of the first and second wireless communication apparatuses 2A and 2B, thereby setting the first and second wireless communication apparatuses 2A and 2B significantly easily.

(4) Other embodiments

In the above-mentioned embodiments, the first and second wireless communication apparatuses 2A and 2B execute wireless data communication with each other on a one to one basis. The present invention is not limited to this configuration. For example, wireless data communication may be practiced between one wireless communication apparatus 2C and a plurality of wireless communication apparatuses 2D, 2E, and 2F as shown in FIG. 18.

In this case, for example, the third wireless communication apparatus 2C has a switch SW electrically or physically arranged for switching between three pieces of stored temporary setting information Itx, Ity, and Itz. In the example shown in FIG. 18, three pieces of temporary setting information Itx, Ity, and Itz stored in the third wireless communication apparatus 2C correspond to different pieces of cryptographic key information WK. The third wireless communication apparatus 2C writes

temporary setting information Itx, Ity, or Itz selected by the switch SW to the non-contact IC card 3 brought to the proximity of the apparatus 2C. Consequently, the user executes a job of writing temporary setting information It, Ity, and Itz selected by the switch SW to the non-contact IC card 3. Then, the user executes to store temporary setting information Itx, Ity, and Itz stored in the non-contact IC card 3 into a fourth to sixth wireless communication apparatuses 2D, 2E, and 2F respectively. Thus, setting information Ix, Iy, and Iz having different pieces of cryptographic key information WK are set to these apparatuses 2D, 2E, 2F and setting information Ix', Iy', and Iz' corresponding to setting information Ix, Iy, and Iz are set to the third wireless communication apparatus 2C. As a result, operating the switch SW so as to use setting information Iz' of the third wireless communication apparatus 2C allows wireless data communication between the sixth wireless communication 2F having setting information Iz corresponding to setting information Iz' and this third wireless communication apparatus 2C, as shown in FIG. 19.

In the above-mentioned embodiments, cryptographic key information WK has already been set in temporary setting information It shown in FIG. 3A. The present

invention is not limited to this configuration. For example, this cryptographic key information WK may be randomly generated immediately before the first wireless communication apparatus 2A writes temporary setting information It to the non-contact IC card 3.

In the above-mentioned embodiments, the first and second wireless communication apparatuses 2A and 2B execute detection processing in accordance with a non-contact IC card detection command operation done by the user. The present invention is not limited to this configuration. For example, the first and second wireless communication apparatuses 2A and 2B may execute detection processing on their own.

In the above-mentioned embodiments, personal computers for example are used for the first and second wireless communication apparatuses 2A and 2B. The present invention is not limited to this configuration. For example, other various kinds of information processing devices may be used, such as PDAs (Personal Digital Assistances) for the first and second wireless communication apparatuses 2A and 2B.

In the above-mentioned embodiments, the non-contact IC card 3 that wirelessly communicates on the basis of FeliCa (trademark) modulating of 13.56 MHz or ISO

14443A/B for example is applied as the proximity wireless communication apparatus that wirelessly communicates with wireless communication apparatuses arranged in the proximity of a predetermined range. The present invention is not limited to this configuration. For example, proximity wireless communication apparatuses based on various other wireless communication methods, such as Bluetooth (trademark) may be applied. In the above-mentioned embodiments, the non-contact IC card 3 having a size of a business card for example is assumed as the proximity wireless communication apparatus. The present invention is not limited to this configuration. For example, a mobile phone incorporating this non-contact IC card 3 is also applicable.

In the above-mentioned embodiments, the control block 5 of each of the first and wireless communication apparatuses 2A and 2B executes, by means of software, the above-mentioned setting processing procedure RT1, temporary setting information write processing procedure SRT1, and temporary setting information read processing procedure SRT2 in accordance with pre-installed programs. The present invention is not limited to this configuration. For example, circuits for executing the above-mentioned setting processing procedure RT1,

temporary setting information write processing procedure SRT1, and temporary setting information read processing procedure SRT2 may be arranged on the first and second wireless communication apparatuses 2A and 2B, thereby executing these procedures by means of hardware. Also, programs for executing these procedures may be recorded to a recording medium such as CD (Compact Disc).

The present invention is applicable to the setting of a plurality of wireless communication apparatuses such that these apparatuses can wirelessly communicate with each other.

It should be understood by those skilled in the art that various modifications, combinations, sub-combinations, and alternations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

WHAT IS CLAIMED IS:

1. A wireless communication system comprising:

a plurality of wireless communication apparatuses each having a setting block to which a wireless data communication destination is set and a wireless data communication block for executing wireless data communication with said wireless data communication destination set to said setting block; and

a proximity wireless communication apparatus for executing wireless communication with any of said plurality of wireless communication apparatuses brought into proximity of a predetermined range of said proximity wireless communication apparatus;

wherein said proximity wireless communication apparatus includes

a storage block for storing communication mate identification information received from said wireless communication apparatuses brought into proximity of said proximity wireless communication apparatus for identifying said wireless communication apparatus as a communication mate, and

a wireless transmission block for transmitting communication mate identification information if stored in said storage block to said

wireless communication apparatus brought into proximity of said proximity wireless communication apparatus; and  
said plurality of wireless communication apparatuses each includes

a wireless transmission block for transmitting, to said proximity wireless communication apparatus, communication mate identification information, if said communication mate identification information is not stored in said proximity wireless communication apparatus brought into proximity of said wireless communication apparatus, for identifying said wireless communication apparatus itself as a communication mate, and

a setting control block for setting said wireless communication apparatus to said setting block as a wireless data communication destination, said wireless communication apparatus being identified by said communication mate identification information received from said proximity wireless communication apparatus if said communication mate identification information is stored in said proximity wireless communication apparatus brought into proximity of said wireless communication apparatus.

2. The wireless communication system according to

claim 1 wherein said plurality of wireless communication apparatuses each transmit communication mate identification information for identifying any one of said plurality of wireless communication apparatuses as a communication mate by said wireless data communication destination set to said setting block.

3. The wireless communication system according to claim 1 or 2, wherein said proximity wireless communication apparatus

stores, upon reception of wireless network identification information for identifying a wireless network along with said communication mate identification information from any one of said plurality of wireless communication apparatus, the received wireless network identification information into said storage block, and

transmits said wireless network identification information to any one of said plurality of wireless communication apparatuses brought to proximity of said proximity wireless communication apparatus along with said communication mate identification information if said wireless network identification information is stored in said storage block along with said communication mate identification information; and

any one of said plurality of wireless communication

apparatuses

transmits said wireless network identification information to said proximity wireless communication apparatus along with communication mate identification information for identifying said wireless communication apparatus itself as a communication mate if said communication mate identification information and said wireless network identification information are not stored in said proximity wireless communication apparatus brought to proximity of said wireless communication apparatus, and

receives said wireless network identification information to be transmitted along with said communication mate identification information from said proximity wireless communication apparatus to set the received wireless network identification information to said setting block if said communication mate identification information and said wireless network identification information are stored in said proximity wireless communication apparatus brought to proximity of said wireless communication apparatus;

thereby executing wireless data communication with any one of said plurality of wireless communication apparatuses that has been set to said setting block as a

wireless data communication destination among said plurality of wireless communication apparatuses identified by said wireless network identification information set to said setting block.

4. The wireless communication system according to anyone of the preceding claims wherein said proximity wireless communication apparatus

stores, upon reception of cryptographic key information for encrypting data along with said communication mate identification information, the received cryptographic key information into said storage block, and

transmits said cryptographic key information to said wireless communication apparatus brought to proximity of said proximity wireless communication apparatus along with said communication mate identification information if said cryptographic key information is stored in said storage block along with said communication mate identification information; and

said wireless communication apparatus

transmits said cryptographic key information to said proximity wireless communication apparatus along with communication mate identification information for identifying said wireless communication apparatus itself

as a communication mate if said communication mate identification information and said cryptographic key information are not stored in said proximity wireless communication apparatus, and

receives said cryptographic key information from said proximity wireless communication apparatus along with said communication mate identification information to set the received cryptographic key information to said setting block if said communication mate identification information and said cryptographic key information are stored in said proximity wireless communication apparatus;

thereby, while executing wireless data communication with said wireless communication apparatus set to said setting block as a wireless data communication destination, decrypting encrypted data received by said wireless data communication by use of said cryptographic key information set to said setting block and encrypting data to be transmitted by said wireless data communication by use of said cryptographic key information set to said setting block.

5. A wireless communication setting method for a wireless communication system having a plurality of wireless communication apparatuses each having a setting

block to which a wireless data communication destination is set and a wireless data communication block for executing wireless data communication with said wireless data communication destination set to said setting block, and a proximity wireless communication apparatus for executing wireless communication with any of said plurality of wireless communication apparatuses brought into proximity of a predetermined range of said proximity wireless communication apparatus;

said wireless communication setting method comprising the steps of:

in said proximity wireless communication apparatus, storing communication mate identification information received from said wireless communication apparatuses brought into proximity of said proximity wireless communication apparatus for identifying said wireless communication apparatus as a communication mate; and

transmitting communication mate identification information if stored in said storage block to said wireless communication apparatus brought into proximity of said proximity wireless communication apparatus; and

in each of said plurality of wireless communication apparatuses,

transmitting communication mate identification information to said proximity wireless communication apparatus if said communication mate identification information is not stored in said proximity wireless communication apparatus brought into proximity of said wireless communication apparatus, for identifying said wireless communication apparatus itself as a communication mate; and

setting said wireless communication apparatus to said setting block as a wireless data communication destination, said wireless communication apparatus being identified by said communication mate identification information received from said proximity wireless communication apparatus if said communication mate identification information is stored in said proximity wireless communication apparatus brought into proximity of said wireless communication apparatus.

6. A wireless communication apparatus comprising:  
a setting block to which a wireless data communication destination is set;

a wireless data communication block for executing wireless data communication with said wireless data communication destination set to said setting block;

a wireless transmission block for, if a proximity

wireless communication apparatus having a storage block for storing communication mate identification information received from a wireless communication apparatus brought to proximity of a predetermined range of said proximity wireless communication apparatus for identifying said wireless communication apparatus as a communication mate and a wireless transmission block for transmitting said communication mate identification information if stored in said storage block to said proximity wireless communication apparatus, does not store said communication mate identification information, transmitting communication mate identification information for identifying said wireless communication apparatus itself as a communication mate to said proximity wireless communication apparatus; and

a setting control block for, if said communication mate identification information is stored in said proximity wireless communication apparatus brought to proximity of said wireless communication apparatus, receiving said communication mate identification information from said proximity wireless communication apparatus and setting said wireless communication apparatus identified by the received communication mate identification information to said setting block as a

wireless data communication destination.

7. A wireless communication setting program  
comprising the steps of:

in a wireless communication apparatus having a  
setting block to which a wireless data communication  
destination is set and a wireless data communication  
block for executing wireless data communication with said  
wireless data communication destination set to said  
setting block,

wirelessly transmitting, if a proximity wireless  
communication apparatus having a storage block for  
storing communication mate identification information  
received from a wireless communication apparatus brought  
to proximity of a predetermined range of said proximity  
wireless communication apparatus for identifying said  
wireless communication apparatus as a communication mate  
and a wireless transmission block for transmitting said  
communication mate identification information if stored  
in said storage block to said proximity wireless  
communication apparatus, does not store said  
communication mate identification information,  
communication mate identification information for  
identifying said wireless communication apparatus itself  
as a communication mate to said proximity wireless

communication apparatus; and

setting, if said communication mate identification information is set to said proximity wireless communication apparatus brought to proximity of said wireless communication apparatus, said wireless communication apparatus identified by the communication mate identification information received from said proximity wireless communication apparatus to said setting block as a wireless data communication destination.

8. A storage medium storing a wireless communication setting program comprising the steps of:

in a wireless communication apparatus having a setting block to which a wireless data communication destination is set and a wireless data communication block for executing wireless data communication with said wireless data communication destination set to said setting block,

wirelessly transmitting, if a proximity wireless communication apparatus having a storage block for storing communication mate identification information received from a wireless communication apparatus brought to proximity of a predetermined range of said proximity wireless communication apparatus for identifying said

wireless communication apparatus as a communication mate and a wireless transmission block for transmitting said communication mate identification information if stored in said storage block to said proximity wireless communication apparatus, does not store said communication mate identification information, communication mate identification information for identifying said wireless communication apparatus itself as a communication mate to said proximity wireless communication apparatus; and

setting, if said communication mate identification information is set to said proximity wireless communication apparatus brought to proximity of said wireless communication apparatus, said wireless communication apparatus identified by the communication mate identification information received from said proximity wireless communication apparatus to said setting block as a wireless data communication destination.